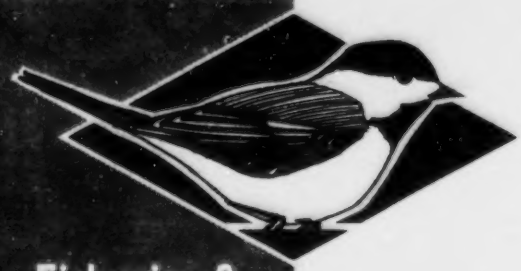
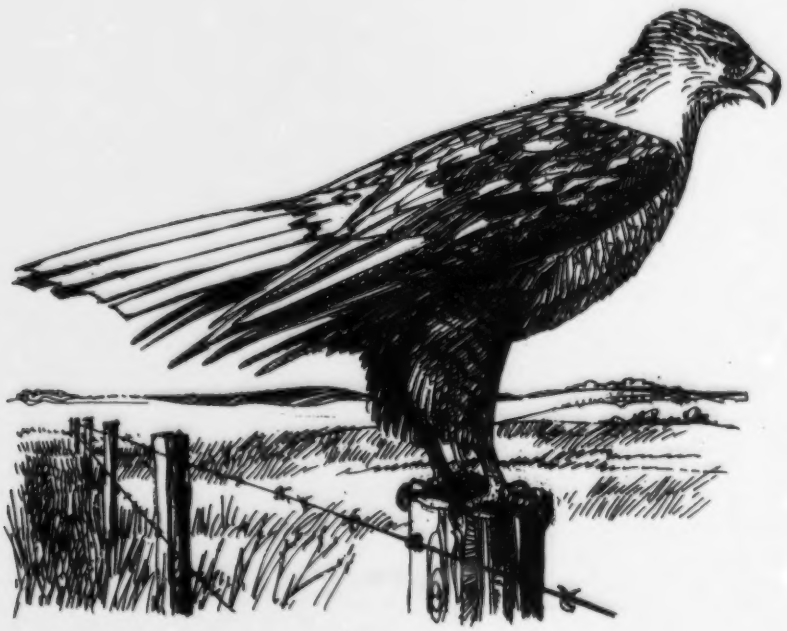


Fisheries & Wildlife Management Division

RESOURCE STATUS AND ASSESSMENT BRANCH

Status of the Ferruginous Hawk (Buteo regalis) in Alberta

Josef K. Schmutz



Alberta Wildlife Status Report No. 18

Alberta

Alberta Conservation Association

Status of the Ferruginous Hawk (Buteo regalis) in Alberta

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PREFACE

Every five years, the Fisheries and Wildlife Management Division of Alberta Natural Resources Service reviews the status of wildlife species in Alberta. These overviews, which have been conducted in 1991 and 1996, assign individual species to 'colour' lists that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A primary objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the 1996 *Status of Alberta Wildlife* review process, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are potentially at risk in the province (Red or Blue listed), that are of uncertain status (Status Undetermined), or which are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fisheries and Wildlife Management Division of Alberta Environmental Protection, and are intended to provide detailed and up-to-date information which will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information which will assist the Alberta Endangered Species Conservation Committee to identify species that may be formally designated as endangered or threatened under the Alberta Wildlife Act. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The Ferruginous Hawk (Buteo regalis) is currently listed as a 'vulnerable' species in Canada and is considered an 'endangered' species under the Alberta Wildlife Act. This report summarizes information about the Ferruginous Hawk in Alberta, as a step in updating its status in the province.

The Ferruginous Hawk ranges within the Great Plains of North America, breeding almost exclusively in grassland or shrub-steppe habitats. In Alberta, the species is tied to landscapes with at least 50% natural grassland and that support ground squirrel prey populations. Suitable breeding areas tend to occur where grazing is the dominant land use.

The distribution of the Ferruginous Hawk has been greatly reduced since European settlement. Estimates of range contraction include approximately 40% reduction in Alberta and 50% in Canada. Although population levels are thought to have declined by at least 50% since the 1920s, current population levels in Alberta are thought to have stabilized. Similarly, throughout the Ferruginous Hawk's range, evidence from Breeding Bird Surveys, Christmas Bird Counts and hawk watching stations suggest that population levels are stable and may be increasing slightly. However, recent declines in nesting pairs in the Hanna area may be cause for concern and may be indicative of a more extensive downward population trend. Threats to the survival of the Ferruginous Hawk in Alberta include habitat alteration through cultivation and fire suppression, food availability, human disturbance, and availability of nesting sites.

The Ferruginous Hawk is likely not in immediate danger of extirpation in Alberta. Nevertheless, the survival of the species in the province is tied to the preservation of large tracts of natural grasslands with adequate prey populations. Although some cautious optimism regarding the status of the species is warranted, recent concern over declining ground squirrel populations suggest that the Alberta population of Ferruginous Hawks remains vulnerable to future population declines. Monitoring of known nesting areas and prey populations need to continue in order to assess population trends and potential limiting factors.

ACKNOWLEDGEMENTS

I thank Gordon Court (Alberta Environmental Protection), Gary Erickson (Alberta Environmental Protection) and Wayne Harris (Saskatchewan Environment and Resource Management) for their helpful suggestions on this manuscript. Stuart and Mary Houston kindly provided data on old egg collections. This summary of information was possible because a great many people helped secure previous funding, assisted in recording information on Ferruginous Hawks in the field, and shared ideas about conservation events and strategies. Organizations that funded past work include: Alberta Agriculture, Alberta Environmental Research Trust, Alberta Power Ltd., Alberta Sport, Recreation, Parks and Wildlife Foundation, Alberta Environmental Protection, Arctic Institute of North America, Environment Canada, Petro-Canada, Renaissance Petroleum Ltd., Special Areas Board, Hanna, University of Saskatchewan, and World Wildlife Fund Canada. Information is only as good as its parts. Many people whose work I relied on here, spent countless hours recording information meticulously. These people include Harry Armbruster (Canadian Wildlife Service), Ursula Banasch (Canadian Wildlife Service), Ron Bjorge (Alberta Environmental Protection), Steve Brechtel (Alberta Environmental Protection), Léo Dubé (Alberta Environmental Protection), Gary Erickson (Alberta Environmental Protection), Magnus Flood, Ken Froggatt (Alberta Environmental Protection), Richard Fyfe (Canadian Wildlife Service), Bob Goddard (Alberta Environmental Protection), Leo Gudmundson (Alberta Environmental Protection), Richard Griebel, Bill Hall (Alberta Environmental Protection), Ed Hofman (Alberta Environmental Protection), Dan Hungle (Special Areas Board), Carolyn Ross, Sheila Schmutz (University of Saskatchewan), Helen Trefry (Canadian Wildlife Service), Ron Weatherill (Alberta Environmental Protection), and Dan and Gwen Wood (Wild Prairie Photographics). Research assistants in the Hanna project were Doug Clayton, Doug Hooper, Jane Jenkins, Laurie King, Russell Meschishnick, David Moody, Karrie Rose, Howard Samoil, Jeff Smith, Skylar Rickabaugh, and Dave Wieder. To reach Ferruginous Hawks, rural people had to participate and I gratefully acknowledge them all. During the Ferruginous Hawk surveys, we barged in on the lives of 345 farm/ranch families. The vast majority of people were polite, many were interested, and some took us into their homes. In the Hanna study area, the travels of the "hawk man" and his entourage across the land of 27 families was a regular occurrence for 18 years. Karen and Greg Gordon, in particular, were invaluable assets to the project.

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INTRODUCTION

The Ferruginous Hawk (Buteo regalis) is one of three Buteos or 'soaring hawks' that regularly breed in Alberta's grasslands. The species is currently listed as 'endangered*' under the Alberta Wildlife Act and, Canada-wide, is considered 'vulnerable' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1999).

The Ferruginous Hawk has a restricted prairie distribution, and compared to other prairie hawks, (e.g., Red-tailed Hawks, B. jamaicensis; Swainson's Hawks, B. swainsoni) has not adjusted well to habitat alteration on the prairies. The Ferruginous Hawk now occupies only parts of the southern 60% of the range it occupied around 1900 (Schmutz 1984).

This report summarizes historical and recent information on the Ferruginous Hawk in Alberta as a step in updating the status of the species in the province.

HABITAT

The Ferruginous Hawk is frequently described as a hawk of the "open country". The species ranges exclusively within the Great Plains of North America, occupying flat rolling terrain in grassland or shrub-steppe regions (Bechard and Schmutz 1995). Ecoregions in which the Ferruginous Hawk can be found in Alberta include Dry Mixed-grass, Mixed-grass, Fescue and Aspen Parkland (Strong and Leggat 1992). Generally, the Ferruginous Hawk occurs in desert shrub and grassland regions, west and east of the Rocky Mountains. In all areas except Washington (Fitzner et al. 1977), the Ferruginous Hawk nests where grazing is the dominant land use or where the open landscape is otherwise relatively wild (e.g., military reserves).

Although the Ferruginous Hawk may coexist with the Red-tailed and Swainson's Hawk, each of the three species of Buteo is specialized to exist without one or the other in a portion of their range. The Ferruginous Hawk tends to exist without the Red-tailed or Swainson's Hawk in the treeless and arid grasslands or desert habitats where it can nest on eroded banks and even relatively level ground (Bechard and Schmutz 1995). In contrast, the Red-tailed Hawk is strongly associated with woodlands, and on the dry plains relies on wooded river valleys (Godfrey 1966). The Swainson's Hawk is adaptable, occupying the interface between the two habitats (England et al. 1997) using shrubs for nesting when trees are not available. The Swainson's Hawk also has adapted to agricultural activity and can be abundant in intensively cultivated regions, in marked contrast to the Ferruginous Hawk (Schmutz 1989).

Ferruginous Hawk density within prairie subregions is dependent on the amount of remaining native vegetation. Ferruginous Hawk nesting density decreases consistently as cultivation increases and nesting hawks occur in significantly higher densities in areas with 51% or more native grassland (Schmutz 1993a; Figure 1). Landscapes with sufficient natural grassland for the Ferruginous Hawk tend to exist where cattle or sheep grazing is the dominant land use (Schmutz 1989, 1993a). However, Ferruginous Hawk density increases with small amounts of cultivation (Schmutz 1993a, Figure 1). This could reflect that the hawks benefit through food chain effects arising from the agricultural inputs that elevate productivity, or, that lands that now remain in continuous grasslands, without natural disturbances such as wildfires, are inherently lower in productivity. For example,

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* See Appendix 1 for definitions of selected status designations

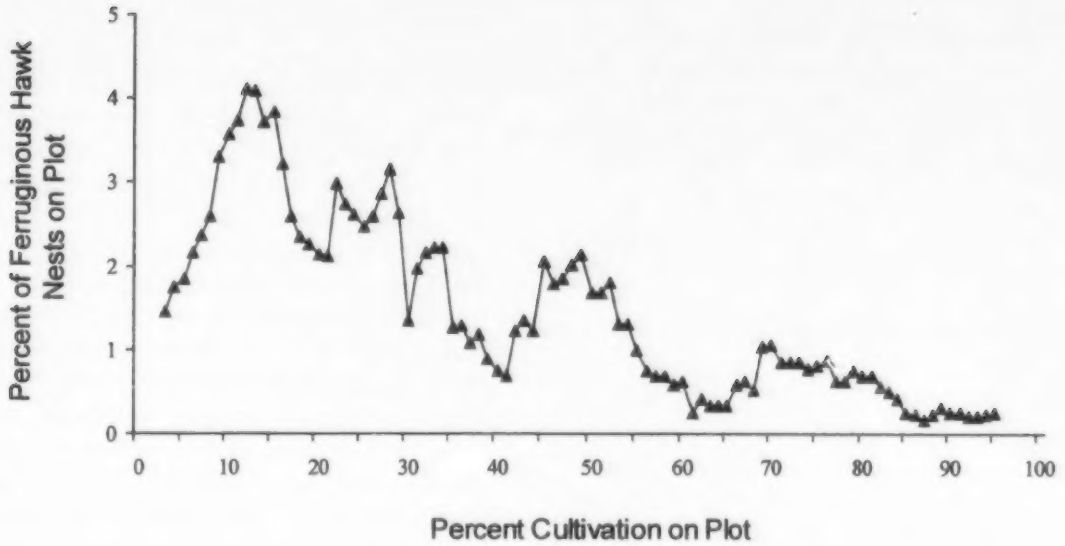

Figure 1. Percent of Ferruginous Hawk nests in relation to percent cultivation on survey plots in 1982, 1987 and 1992 (see 'Population Size and Trend' section, below; Schmutz 1993a). The connected triangles represent a moving average for an 8% cultivation span at a time.

Ferruginous Hawk breeding density across randomly selected study plots in Alberta exhibited a pattern similar to the abundance of its main prey, ground squirrels. Both hawks and ground squirrels increased as percent of cultivation on plots increased, peaked, and then declined as cultivation approached and exceeded 50% (Schmutz 1989).

CONSERVATION BIOLOGY

Ferruginous Hawks are usually monogamous and have only one mate for one to several breeding seasons (Bechard and Schmutz 1995). There are no identified subspecies or races recognized. Major differences in appearance of individuals result from variation in plumage (Bechard and Schmutz 1995). A dark morph, which occurs in approximately 10% of individuals, appears black on belly, back and wings from a distance. This contrasts with the more common light morph, where feathers on back, legs and wings are a mix of rusty 'ferruginous' brown, gray and white. Both morphs have a grayish tail.

These large hawks (males 977-1347 g, and females 1501-2074 g) arrive in Alberta in late March to early April (Schmutz et al. 1980, Dolman 1994). Pairing takes place prior to or soon after arrival to the nesting grounds. The Ferruginous Hawk may use a variety of nesting substrates such as trees, abandoned farmsteads or level ground. Ground nesting was likely more prevalent in the past (Rolfe 1896) before trees became more common due to post-settlement fire suppression, and the planting of shelterbelts (Bechard and Schmutz 1995). On average, hawks produce more young in elevated nests than ground nests likely because

nests are further out of reach of predators and disturbance (Fitzner et al. 1977, Schmutz et al. 1984). Ferruginous Hawks are also more prone to initiate breeding when suitable nests are available (Schmutz et al. 1988) and nests on near level ground appear to be used only under extreme nest shortages and superabundance of food. Nest building starts in April and females lay one to five (mean 3.6; Schmutz and Hungle 1989) eggs in April or early May.

Only the female Ferruginous Hawk has a brood patch for incubation, although the male may shelter warm eggs briefly (Bechard and Schmutz 1995). The male is the main provider of food, especially until the fledging of young. The youngest recorded breeders were two years old (i.e., hatched two seasons before; Bechard and Schmutz 1995).

Between 1975-77, the first young in a total of 70 nests near Hanna hatched over a 15-day period, with mean hatch dates of 26 and 27 May and 4 June, respectively (Schmutz et. al 1980). Hatching success in Alberta after 32 days of incubation is generally high, and an average of 2.1 young per occupied nest survive to fledging at five to six weeks of age (Schmutz and Hungle 1989). Mortality during the first year is high (estimated at 65%; Schmutz and Fyfe 1987), but much lower among adults (estimated at 25%; Woffinden and Murphy 1989). Fledglings and adults generally remain near their nest for one month, or may move a short distance to favorite hunting areas within the territory. In August, young drift away and begin their migration. Adults follow later, remaining on the nesting area as late as mid-October (Bechard and Schmutz 1995).

Throughout its range, the Ferruginous Hawk primarily relies on only two families of mammals for the majority of its food; Leporidae (rabbits and hares) and Sciuridae (ground squirrels and prairie dogs). Collating results from 20 diet studies in the United States and Canada, Olendorff (1993) reported that rabbits and hares comprised 66% of the Ferruginous Hawk's diet by biomass (20% by items), and ground squirrels and prairie dogs 25% by biomass (44% by items). In contrast to the desert-shrub ecosystems in the western United States, however, white-tailed jack rabbits (Lepus townsendii) have played a minor role in the diet of the Ferruginous Hawk in Alberta where the species likely has an overwhelming reliance on ground squirrel prey (Schmutz et al. 1980).

Much evidence exists from Alberta suggesting a strong link between Ferruginous Hawk density and/or reproductive success and ground squirrel abundance. Schmutz et al. (1980) found that not only were ground squirrels (largely Richardson's ground squirrels, Spermophilus richardsonii) the most important prey item for the Ferruginous Hawk overall, but that during the nestling period ground squirrels made up 89% of prey items. Like other raptors that prefer large rodent prey, the Ferruginous Hawk produces larger clutches than other Buteo hawks that occur at the same latitude (Newton 1979). Buteos that rely the most on rodent prey also show the greatest fluctuations in reproduction depending on rodent prey density (Newton 1979). Their specialization on ground squirrel prey may be a substantial reason why the Ferruginous Hawk reproduces so well in years of high ground squirrel numbers (see Schmutz and Hungle 1989).

The link between prey abundance and Ferruginous Hawk distribution was also evident in a two-year study of wintering Ferruginous Hawks in New Mexico. Ferruginous Hawks were abundant during migration but the numbers residing in the area in winter declined with a loss of Gunnison's

prairie dogs (Cynomys gunnisoni) during an outbreak of plague (Cully 1991). In contrast, Red-tailed Hawks did not decline during the plague (Cully 1991).

The possibility of reduced genetic variability in the Ferruginous Hawk has been suggested based on the extensive habitat loss and isolation of some Ferruginous Hawk populations in Canada, and given a possible population decline (bottleneck) during the drought and low ground squirrel populations of the 1930s (Houston and Bechard 1984). Portman (1997) sampled one nestling Ferruginous Hawk from 94 nests in eight study populations stretching from southwestern Manitoba through southern Alberta and southeastern Idaho. Band sharing among DNA fingerprints and estimates of heterozygosity suggested that genetic diversity among the sampled populations is high, and similar to other populations of 'outbred' birds (Portman 1997). An analysis of population subdivision indicated that there is considerable gene flow among Ferruginous Hawk populations across the northern prairies (Portman 1997). However, a local population of Ferruginous Hawks near High River is an exception as it was found to be genetically different from the population of Ferruginous Hawks near Hanna (Portman 1997). The High River population nests in a western remnant of grassland and it is possible that this habitat fragment is sufficiently isolated that only locally produced, and thus, genetically similar Ferruginous Hawks return to nest there.

DISTRIBUTION

1. Alberta. - Historic records of egg collectors and naturalist explorers of the prairies affirm at least a 40% reduction in the Ferruginous Hawk's breeding distribution in Alberta (Schmutz 1984). While travelling from Yorkton, Saskatchewan to Edmonton, Macoun and Macoun (1909) noted Ferruginous Hawks "regularly and commonly." Godfrey (1966) reported the Alberta range of the Ferruginous Hawk as extending north to near Alliance. Today, a line through Waterton Lakes National Park-Calgary-Drumheller-Hanna-Consort-Altario represents the northern edge of the hawks' range, with isolated pairs north of this edge (Figure 2).

The southeasterly contraction of the Ferruginous Hawk's range is confirmed by the reports from bird watchers and raptor banders in the province. For instance, in 1994, a fledgling not yet able to fly was recorded a few kilometers south of Stettler on Highway 56 (H. Trefry, pers. comm.), indicating the presence of a successfully breeding pair in the area. Similarly, in the late 1980s, observations of nesting pairs of Ferruginous Hawks included one pair approximately 30 km north-northeast of Hanna, two pairs west of Sullivan Lake (south of Castor) and one pair 15 km east of Castor (D. Wood, pers. comm.). The Rosebud Coulee, south-southwest of Drumheller, supported many Ferruginous Hawks in the past based on the banding results of Salt (1939). During a thorough reconnaissance of the Rosebud River Valley and tributaries in the 1980s however, two adults and many old nests were observed but no occupied nests were found (R. Bjorge, pers. comm.). In 1988, observations were made of five abandoned but no occupied Ferruginous Hawk nests along a 20 km stretch of the Red Deer River near Drumheller (J. K. Schmutz, unpubl. data).

2. Continental Range. - In general, the Ferruginous Hawk occurs in western North America. Its breeding range includes 17 states and three provinces from the southern prairie provinces south to northern Arizona and New Mexico (Bechard and Schmutz 1995; Figure 3). The winter range generally extends from northern California, east to southwestern Nebraska, south to east-central Texas, central

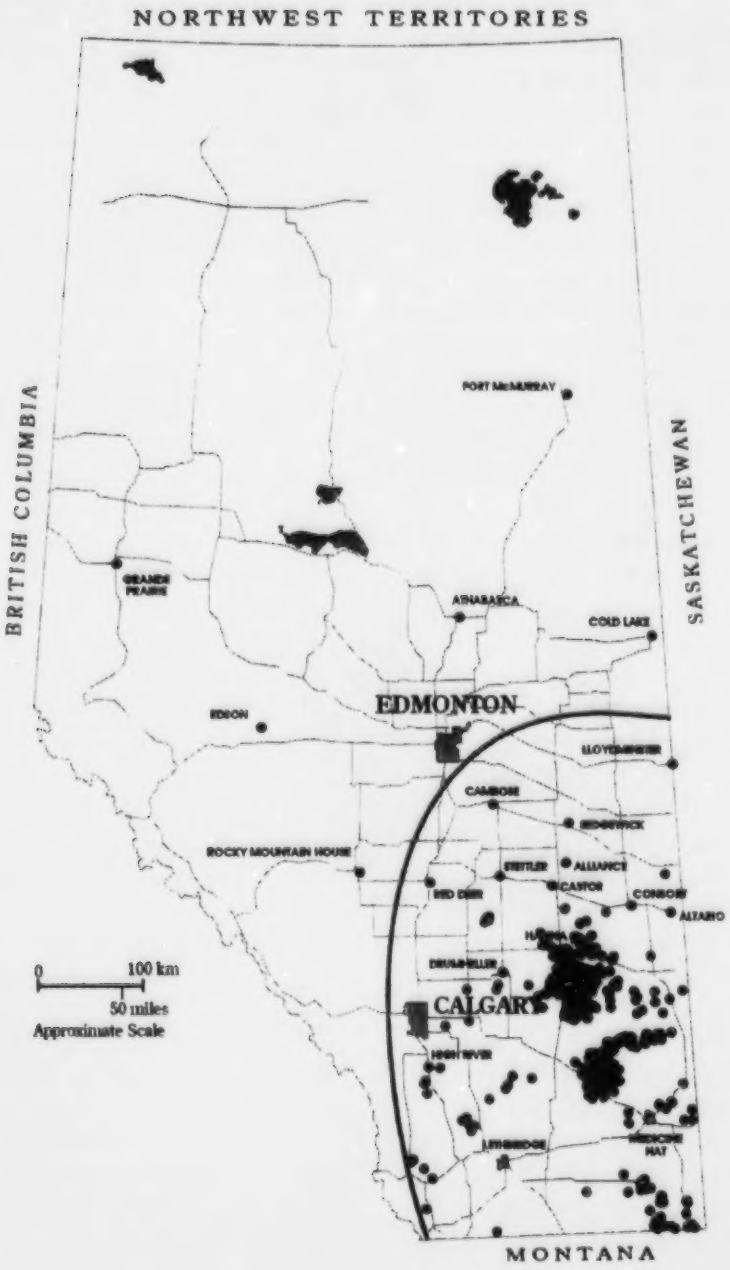

Figure 2. Distribution of the Ferruginous Hawk in Alberta based on observational records from 1967 to 1998. The grey line indicates the Ferruginous Hawk's historic range. Details of individual records can be found in the Biodiversity/Species Observation Database (Alberta Conservation Association and Alberta Environmental Protection 1999).

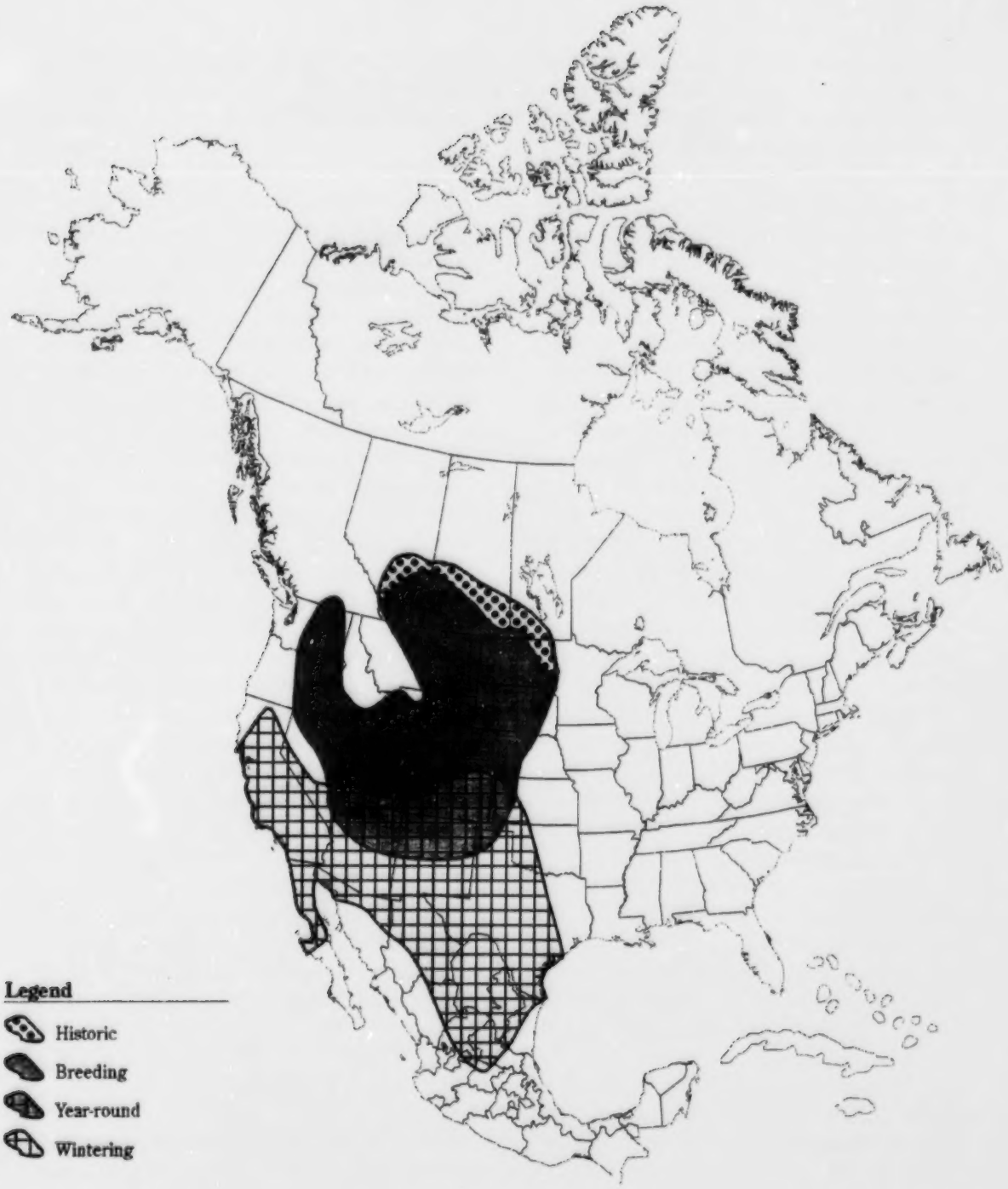

Figure 3. Distribution of the Ferruginous Hawk in North America showing the range contraction in the southeastern portion of the species' range (modified from Schmutz and Schmutz 1980 and Bechard and Schmutz 1995).

Mexico, and Baja California (see Bechard and Schmutz 1995). The majority of Ferruginous Hawks that breed in Alberta winter in Texas (Schmutz and Fyfe 1987).

Approximately 12% of the Ferruginous Hawk's breeding range lies in Canada (Schmutz and Schmutz 1980). In 1980, at the time the Ferruginous Hawk was listed as 'threatened' by the Committee on the Status of Endangered Wildlife in Canada, the species was believed to occupy approximately 48% of its former range in Canada (Schmutz and Schmutz 1980). Patterns of decline in Saskatchewan, Manitoba and British Columbia have been similar in timing and apparently reflect similar habitat changes as have occurred in Alberta. Likely always rare in the province, very few (i.e. less than five) Ferruginous Hawks currently breed in the interior of British Columbia (Campbell et al. 1990). In Saskatchewan, the range of the Ferruginous Hawk has retreated southwesterly to areas where ranching on native range predominates (Houston and Bechard 1984). However, hawks still occur in that province on isolated community pastures in otherwise extensive crop production areas (Banasch et al. 1994). After a period of absence, a small population of Ferruginous Hawks now exists in extreme southwestern Manitoba (Ratcliff 1987, K. De Smet, pers. comm.).

In Canada and the United States, range maps underestimate the degree of decline in Ferruginous Hawk populations, because they do not show the substantial decreases in numbers that have occurred within the range. The vacancy of many historic nest sites during the 1980s has suggested reductions in numbers within the Ferruginous Hawk's core breeding range (Bechard and Schmutz 1995). Throughout their range, Ferruginous Hawks have reportedly declined in comparison to their distribution several decades ago.

POPULATION SIZE AND TREND

1. Alberta. - Data suggest that Alberta supports 12 to 37% of the Ferruginous Hawks in the grassland population east of the Rocky Mountains (Schmutz 1987a). Much of the Ferruginous Hawk's remaining breeding range has not been surveyed. The number of Ferruginous Hawks in Alberta is clearly a dynamic outcome of recruitment and mortality modified by dispersal. Therefore, strict number estimates may have little meaning in their exactness, but the conclusion that Alberta supports a substantial portion of the North American population of Ferruginous Hawks is warranted.

Accurate historic population estimates for the Ferruginous Hawk do not exist. By 1980, however, based on qualitative evidence provided by natural historians and bird enthusiasts, Schmutz and Schmutz (1980) estimated that numbers of Ferruginous Hawks had been reduced by at least half since the 1920s. Over the more recent past, a population trend estimate is available, mainly because of the accomplishment of coordinated survey efforts (Schmutz 1993a). Surveys on 80 to 83 randomly selected 41-km^2 study plots in the prairie region of southern Alberta were conducted in 1982 (Schmutz 1984), 1987 (Schmutz 1989) and 1992 (Schmutz 1993a). The survey region lay south of Consort, southwest of Drumheller, and east of High River and likely included 95% of the Ferruginous Hawks in Alberta (Schmutz 1993a). The survey results showed an increase in the estimated breeding pairs in southeastern Alberta from 1982 to 1987, and a slight decrease from 1987 to 1992 (Table 1; Schmutz 1993a).

Although the entire survey area has not been inventoried since 1992, 27 of the plots were surveyed in 1997 and 5 in 1998 (L. Dubé and

Table 1. The number of estimated pairs of Ferruginous Hawks in southeastern Alberta, 1982-92 (Schmutz 1993a).

Year	Number of Plots	Study Area (km^2)[a]	Nests/Plot	Range	Estimated Number of Pairs	95% Confidence Interval
1982	80	74,686	0.587	0-7	1059	630-1488
1987	83	77,947	0.940	0-6	1770	1265-2275
1992	83	77,947	0.904	0-7	1702	1181-2223

[a] An additional 3261 km^2 was added to the northwest portion of the survey area in 1987 and 1992.

G. Erickson, unpubl. data). On those 32 plots, a total of three Ferruginous Hawk nests were found in 1997-98 (L. Dubé and G. Erickson, unpubl. data) compared to 17 on the same plots in 1992 (Schmutz 1993a), representing an 82% reduction in numbers. This most recent decline in Ferruginous Hawks may have been caused by a decrease in ground squirrel numbers (Jones 1993, J. K. Schmutz, unpubl. data). Nests of Swainson's Hawks, which also rely primarily on ground squirrels for food (Schmutz and Hungle 1989), also declined by 68% on the same plots over the same period of time (Schmutz 1993a, L. Dubé and G. Erickson, unpubl. data).

A similar recent decline in Ferruginous Hawk numbers also took place in a study area near Hanna where surveys were carried out for 18 years during the 1975-95 period (Schmutz and Hungle 1989, J. K. Schmutz, unpubl. data). After approximately 11 years of population stability or increase, the number of breeding Ferruginous Hawks and their brood size declined precipitously starting in 1991 (Figure 4). This decline was concurrent with a decline in numbers of ground squirrels in the study area (J. K. Schmutz, unpubl. data). However, these declines may be temporary and the trend should be monitored.

In 1993, Schmutz (1993a) estimated the current population of Ferruginous Hawks in Alberta to be approximately 1800 breeding pairs. However, based on the recent evidence of a substantial decline in breeding pairs of Ferruginous Hawks and ground squirrels, current numbers of breeding pairs are likely below this level.

2. Other Areas. - Schmutz (1993a) suggested 1000 to 1500 pairs of Ferruginous Hawks breed in Saskatchewan and approximately 50 pairs in Manitoba. Estimates of the entire population of Ferruginous Hawks vary. Schmutz (1987a) estimated the size of the entire grassland population (east of the Rocky Mountains) of Ferruginous Hawks to be 14,000 individuals or 7,000 pairs. Based on reports from across the Ferruginous Hawk's range in Canada and the United States, Olendorff (1993) reported a lower population estimate for 1992 of between 2,921 to 5,665 pairs.

Data from Breeding Bird Survey, Christmas Bird Count and hawk watching stations in the United States provide trends for raptors, including Ferruginous Hawks. Survey-wide, Breeding Bird Survey data show a statistically significant 5.2% mean annual increase of Ferruginous Hawks over the long term (1966-96; Sauer et al. 1997), and a non-significant 8% increase over a recent shorter term (1985-98; Kirk and Hyslop 1998). Records from mountain lookouts in Utah, Nevada and New Mexico from 1983 to 1991 show a non-significant 2% increase in Ferruginous Hawks (Kirk and Hyslop 1998).

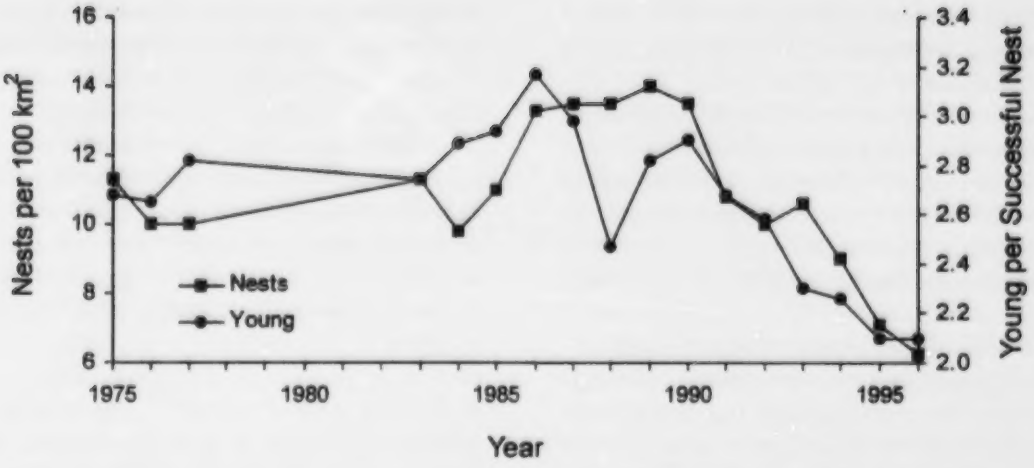

Figure 4. Change in the number of Ferruginous Hawk nests is shown for a 326-480 km² study area over time. The number of young per nest was recorded near fledging for nests from which at least one young fledged. Surveys were not conducted between 1978 and 1982.

LIMITING FACTORS

Limiting factors for the Ferruginous Hawk include those that reduce reproductive success, either directly or indirectly, or increase adult or juvenile mortality. This section stresses those factors that are influenced by human activities.

1. Habitat Alteration. - Post-settlement habitat alteration has resulted in three factors that have negatively affected Ferruginous Hawk populations. Soils within the northern part of the Ferruginous Hawk's range have been extensively cultivated, thus rendering this habitat unsuitable for the species (see 'Habitat' section, above). Fire suppression has further altered this landscape by allowing woodland habitat to expand and replace some remaining patches of grassland (see Houston and Bechard 1983). Finally, following the conversion of grassland to woodland, Swainson's and Red-tailed Hawks have expanded their range to compete with Ferruginous Hawks for space, food and nest sites (Schmutz et al. 1980).

Within its current range, the Ferruginous Hawks' fragmented distribution is strongly linked to remaining grassland (see 'Habitat' section, above). In areas where it still occurs, the Ferruginous Hawk may be highly sensitive to any further loss of habitat and may also be unusually vulnerable to disturbance. For instance, alternate hunting grounds may be unavailable to the hawks in the case of a disturbance. Therefore, the survival of these hawks in a large portion of their range is dependent on a traditional ranching economy where native range prevails.

Perhaps the most far-reaching recent influence in favour of the Ferruginous Hawk is the discontinuation or re-examination of various direct or indirect subsidies that encourage breaking of grasslands. For example, the Canadian Wheat Board removed acreage quotas for barley and wheat in 1993-94 (Thornton et al. 1993) and the Western Grain

Transportation Act's subsidy for the transport of grain was discontinued in 1995 (Ross 1999). Thus the Ferruginous Hawk and other prairie wildlife have likely benefited from the encouragement of diversification in agriculture and a return to permanent cover on some marginal lands. However, crop insurance programs can indirectly encourage the cultivation of marginal lands by providing insurance for those years when yields are low.

2. Food. - Based on abundant and reasonably strong evidence (see 'Conservation Biology' section, above), it appears that Ferruginous Hawk conservation in Alberta is inextricably tied to maintaining their ground squirrel prey. Selective poisoning of ground squirrels to guard against damage to cereal crops does not appear to have a major influence on the hawks through secondary poisoning (Schmutz et al. 1989). However, the removal of ground squirrels could affect hawks that utilize small parcels of grassland within intensive farming areas where they have little or no opportunity to shift to alternate hunting grounds.

Remarkably, there is no evidence that Ferruginous Hawks have been impacted by pesticides (Bechard and Schmutz 1995). While many deferred or indirect deaths likely go unnoticed, it is possible that Ferruginous Hawks are largely uninfluenced by pesticides. Unlike other raptorial birds (e.g., Peregrine Falcon, Falco peregrinus) that rely on migratory bird species as their main prey, the Ferruginous Hawk's simple food chain has few linkages (plants-sciurids-hawks), and only marginally includes insect prey or aquatic habitats where agrochemicals are readily transported.

3. Availability of Nest Sites. - Although the Ferruginous Hawk has vacated the northern parts of its range where trees have invaded, in the south the species largely depends on trees or similar raised structures for nesting. The Ferruginous Hawk prefers elevated nest sites because of the protection they provide (see 'Conservation Biology' section, above) and frequently uses trees in abandoned farmsteads. As these trees die, however, the hawks may be required to relocate to new sites where possible. In areas where trees have died and fallen or in areas where few trees are available, artificial elevated nesting platforms have proven to be a useful management tool (Bechard and Schmutz 1995).

4. Human Disturbance. - The effect of different kinds of human disturbance on Ferruginous Hawks varies (White and Thurow 1985). Newton (1979) reported that the Ferruginous Hawk is sensitive to disturbance at its nest and is likely to desert if disturbance occurs during the egg stage. White and Thurow (1985), however, found that the response of the hawks to disturbance was dependent on the origin and intensity of that disturbance. The effects of human activities that were familiar to the hawks, especially if humans were not visibly associated with those activities, were benign (White and Thurow 1985). In contrast, unfamiliar disturbances caused some Ferruginous Hawks to desert their nests, even after they were apparently accustomed to other forms of disturbance (White and Thurow 1985). What is evident, however, is that Ferruginous Hawks nesting in disturbed areas fledge significantly less young than hawks in relatively undisturbed areas (White and Thurow 1985).

While it is relatively easy to monitor and avoid disturbance at nest sites, the subtle effects of a general disturbance over a larger area are much more difficult to manage. A study in Idaho revealed that fewer raptors, including Ferruginous Hawks, used an area in years when military exercises were carried out (U.S. Department of the Interior 1996). The raptors

that did use the area made only half as many prey capture attempts compared to those in undisturbed areas (U.S. Department of the Interior 1996).

5. Other Factors. - Other limiting factors affect Ferruginous Hawks to varying degrees. Twenty-five known or suspected causes of death of recovered Ferruginous Hawks include 32% by shooting, 32% collision with a vehicle, 20% found injured/sick, and 4% each killed by another raptor, striking a powerline, electrocution and starvation (Schmutz and Fyfe 1987).

STATUS DESIGNATIONS

1. Alberta. - The Ferruginous Hawk is currently listed as an 'endangered' animal under the Alberta Wildlife Act. The species was down-listed from the 1991 provincial 'Red List', to the 'Blue List' in 1996 because although a substantial decline in their range has occurred, hawk numbers had stabilized and the population was apparently not threatened by chance events exacerbated by small population size (Alberta Fish and Wildlife 1991, Alberta Wildlife Management Division 1996). The Alberta Natural Heritage Information Centre ranks the Ferruginous Hawk as S4 meaning the species is 'apparently secure' in the province (Alberta Natural Heritage Information Centre 1998).

2. Other Areas. - The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the Ferruginous Hawk as 'threatened' in 1980. For reasons similar to the down-listing that occurred in Alberta, the Ferruginous Hawk was down-listed to 'vulnerable' in 1995 (Schmutz 1995). The Nature Conservancy (1998) gives the Ferruginous Hawk a global rank of G4 meaning the species is 'apparently secure'. In Saskatchewan, the species has a similar rank of S4 (Saskatchewan Conservation Data Centre 1998). The Ferruginous Hawk is ranked as S2 or 'imperiled' in Manitoba (Duncan 1996) and S1 or 'critically imperilled' in British Columbia (British Columbia Conservation Data Centre 1998). Nature Conservancy ranks in the United States generally range from S4 in the northeastern portion of the Ferruginous Hawks range (e.g., South Dakota Conservation Data Centre 1998) to S2 in the northwest (Washington Conservation Data Centre 1998). The Ferruginous Hawk is not listed by the U.S. Fish and Wildlife Service as an 'endangered' species.

RECENT MANAGEMENT IN ALBERTA

Artificial nests have been used in Alberta as a method to allow Ferruginous Hawks to nest in areas where trees are scarce, and to reduce the impacts of nest predation and disturbance (Schmutz et al. 1984). Ninety-eight nest platforms erected in 1975 were monitored for Ferruginous Hawk use from 1976 to 1983 (Schmutz et al. 1984). Results showed that Ferruginous Hawk nesting density is increased by erecting nesting platforms and, as well, reproductive success is higher in elevated nests (Schmutz 1984). Approximately 3% of Alberta's Ferruginous Hawk population currently uses artificial nests (Schmutz et al. 1984, Schmutz et al. 1988, Schmutz 1993b).

SYNTHESIS

In the face of large-scale ecosystem changes over the last century the range of the Ferruginous Hawk has been reduced by almost half. Nevertheless, the species has persisted in Alberta suggesting that the Ferruginous Hawk is fairly resilient, despite its dependence on native grasslands and specific prey. The existence of over 1000 pairs, coupled with substantial genetic variability, suggests that the

Ferruginous Hawk is not currently threatened with extirpation in Alberta.

There can be little doubt that the key to the conservation of the Ferruginous Hawk in Alberta lies in the protection of rangeland and the prairie wildlife community within it. More specifically, the survival of the Ferruginous Hawk in Alberta is closely linked to the perpetuity of large areas of contiguous grasslands in southeastern Alberta managed under a traditional ranching economy. Generally, cattle grazing ensures habitat that includes some apparently important elements for Ferruginous Hawks: large areas with low disturbance; and native range where plant species diversity is high and where some plant cover is available year-round for rodent prey. The Ferruginous Hawk tolerates an agricultural habitat mosaic where grasslands fitting this description comprise 50% or more of the landscape. If the integrity of such grassland systems can be conserved under increasing human pressure, the prognosis for the Ferruginous Hawk is good.

While some optimism regarding the status of the Ferruginous Hawk in Alberta is warranted, the possibility of future population declines should not be dismissed. For instance, reasons for the recent substantial and persistent decline in ground squirrels and hawks in the Hanna area (and elsewhere) are not clear and this trend should be monitored. Furthermore, conclusions on the status of the Ferruginous Hawk within this report are based on observations from the past. Allowing for some delay in the ecosystem's response, it is conceivable that limiting factors such as the absence of a rejuvenating influence of fire, global warming and the widespread impacts of aerosol pollutants on range productivity may not yet have exerted their full influence on the system. Research into the long-term effects of such factors on the prairie ecosystem on which the Ferruginous Hawk depends should also continue.

The future of Alberta Ferruginous Hawks is not solely dependent on conditions in Alberta. In order to guarantee the survival of the Ferruginous Hawk, conservation initiatives must not only have a provincial focus but an inter-provincial and, indeed, an international dimension.

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APPENDIX 1. Definitions of selected legal and protective designations.

A. Status of Alberta Wildlife colour lists (after Alberta Wildlife Management Division 1996)

Red	Current knowledge suggests that these species are at risk. These species have declined, or are in immediate danger of declining, to nonviable population size
Blue	Current knowledge suggests that these species may be at risk. These species have undergone non-cyclical declines in population or habitat, or reductions in provincial distribution
Yellow	Species that are not currently at risk, but may require special management to address concerns related to naturally low populations, limited provincial distributions, or demographic/life history features that make them vulnerable to human-related changes in the environment
Green	Species not considered to be at risk. Populations are stable and key habitats are generally secure
Undetermined	Species not known to be at risk, but insufficient information is available to determine status

B. Alberta Wildlife Act

Species designated as 'endangered' under the Alberta Wildlife Act include those defined as 'endangered' or 'threatened' by *A Policy for the Management of Threatened Wildlife in Alberta* (Alberta Fish and Wildlife 1985):

Endangered	A species whose present existence in Alberta is in danger of extinction within the next decade
Threatened	A species that is likely to become endangered if the factors causing its vulnerability are not reversed

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 1999)

Extirpated	A species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	A species facing imminent extirpation or extinction
Threatened	A species likely to become endangered if limiting factors are not reversed
Vulnerable	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Not at Risk	A species that has been evaluated and found not to be at risk
Indeterminate	A species for which there is insufficient scientific information to support status designation

D. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range

E. Natural Heritage Element Rarity Ranks (after The Nature Conservancy 1998)

Global or G-rank: Based on the range-wide status of a species.
Sub-national or S-rank: Based on the status of a species in an individual state or province. S-ranks may differ between states or provinces based on the relative abundance of a species in each state or province.

G1 / S1	Critically imperiled because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction
G2 / S2	Imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range
G3 / S3	Either very rare or local throughout its range, or found locally in a restrcited range (21 to 100 occurrences)
G4 / S4	Apparently secure, though it might be quite rare in parts of its range, especially at the periphery
G5 / S5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery

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